CLAIMS:

1. A lithographic projection apparatus comprising:

a radiation system to provide a projection beam of radiation;

a support structure to support patterning structure, the patterning structure serving to pattern the projection beam, according to a desired pattern, in an object plane traversed by the projection beam;

a substrate table to hold a substrate;

a projection system downstream of said object plane, to project the patterned beam onto a target portion of the substrate;

an interferometric measurement system to measure wave front aberrations of the projection system, the interferometric measurement system including:

a grating, including a grating pattern in a grating plane, said grating being movable into and out of the projection beam, such that the grating plane is substantially coincident with said object plane;

a pinhole, including a pinhole pattern in a pinhole plane and arranged in a pinhole plate, said pinhole being movable into and out of the projection beam, such that the pinhole plane is substantially coincident with a plane downstream of the projection system and optically conjugate to said object plane, and

a detector having a detector surface substantially coincident with a detection plane, said detection plane located downstream of the pinhole at a location where a spatial distribution of the electric field amplitude of the projection beam is substantially a Fourier transformation of a spatial distribution of the electric field amplitude of the projection beam in the pinhole plane.

2. A lithographic projection apparatus according to claim 1, wherein the patterning structure is a mask and the support structure is a mask table.

3. A lithographic projection apparatus according to claim 2, wherein the interferometric measurement system comprises a grating module to be held by the mask table at a location for holding the mask, the grating being provided to the grating module.

4. A lithographic projection apparatus according to claim 1, wherein said grating is provided to the support structure at a location away from a location for holding the patterning structure.

5. A lithographic projection apparatus according to claim 1, wherein the patterning structure additionally serves to pattern the projection beam according to the grating pattern.

6. A lithographic projection apparatus according claim 1, wherein said measurement system further comprises a lens having a positive back focal distance, said lens being positioned between the radiation system and the grating at a distance to the grating plane which is substantially equal to said back focal distance.

7. A lithographic projection apparatus according to claim 1, wherein said detector is provided to the substrate table.

8. A lithographic projection apparatus according to claim 1, wherein said pinhole plate is provided to the substrate table.

9. A lithographic projection apparatus according to claim 1, wherein the measurement system comprises a sensor module to be held by the substrate table at a location for holding the substrate, said sensor module comprising the detector and the pinhole plate.

10. A method of measuring wave front aberrations of a projection system in a lithographic projection apparatus comprising:

projecting a patterned beam of radiation onto a target portion of a substrate having a radiation sensitive material thereon;

providing a grating, featuring a grating pattern in a grating plane, into the projection beam, such that the grating plane is substantially coincident with an object plane including patterning structure;

providing a pinhole and a detector to the projection beam at a location downstream of a projection system, such that radiation traversing the pinhole is detectable by the detector, whereby said pinhole is arranged in a pinhole plate and features a pinhole pattern in a pinhole plane, the pinhole plane being substantially coincident with a plane that is optically conjugate to said object plane, and whereby said detector comprises a detector surface that is substantially coincident with a detection plane downstream of the pinhole, whereby, in said detection plane, a spatial distribution of the electric field amplitude of the projection beam is substantially a Fourier transformation of a spatial distribution of the electric field amplitude in the pinhole plane;

illuminating the grating with the projection beam of radiation, and

detecting an interference fringe pattern of radiation with said detector .

11. A method according to claim 10, wherein said grating pattern has a grating period in a first direction along which the grating pattern is periodic, and is moved in said first direction, over a distance equal to a phase step, from a first position to a second position, after detecting the radiation, to repeat detecting the radiation at said second position of the grating pattern.

12. A method according to claim 11, wherein the distance equal to a phase step is at most one of n times the grating period and $(n + i)$ times the grating period, where $0.3 < n < 0.4$ and where i is an integer number.

13. A method according to claim 10, wherein said grating pattern has a grating period along a first axis, along which the grating pattern is periodic, and wherein the pinhole pattern and the detector both have a first position and are moved along said first axis, over a distance equal to a phase step, to a second position, after detecting the radiation, to repeat detecting the radiation at said second position of the pinhole pattern and the detector.

14. A method according to claim 10, wherein said grating pattern has a grating period in a first direction and, during detection of the radiation traversing the pinhole, the support structure and the substrate table are moved in a direction parallel to said first direction, the substrate table having a speed equal to the magnification of the projection system times the speed of the support structure.

15. A method according to claim 10, wherein a calibration of a preselected plurality of coefficients which associate positions at the detector surface to corresponding positions in a plane comprising the pupil, is obtained by a method comprising the steps of:

obtaining a first plurality of measurement data representative of a first wave front aberration for a preselected field point;

applying a preselected displacement, parallel to the optical axis of the projection system, to the pinhole and the detector;

obtaining a second plurality of measurement data representative of a second wave front aberration for said preselected field point at said preselected displaced position of the pinhole and the detector;

calculating the expected difference between the first and the second wave front aberration using an optical system simulation computer program;

calculating the measured difference between the first and the second wave front aberration using said preselected plurality of coefficients and said first and second plurality of measurement data;

minimizing the difference between said expected and said measured difference by adapting said plurality of coefficients, which associate a position at the detector surface to a position in a plane comprising the pupil; and

replacing the preselected plurality of coefficients by the adapted plurality of coefficients.